

1     What is Claimed Is:

2             1.     A clamp for installation on a feedwater sparger end bracket assembly having  
3     an attachment plate connected to an end plate of a feedwater sparger within a boiling  
4     water reactor vessel, said clamp comprising

5             a first clamp member including a first internal compartment and a first opening  
6     communicating with said first internal compartment, said first internal compartment being  
7     defined between a pair of first internal walls of said first clamp member, said first internal  
8     walls being spaced from one another to receive a first portion of the attachment plate and  
9     a first portion of the end plate therebetween with a close fit;

10            a second clamp member including a second internal compartment and a second  
11   opening communicating with said second internal compartment, said second internal  
12   compartment being defined between a pair of second internal walls of said second clamp  
13   member, said second internal walls being spaced from one another to receive a second  
14   portion of the attachment plate and a second portion of the end plate therebetween with  
15   a close fit, said second opening being spaced from and in alignment with said first opening  
16   in facing relation therewith, said first and second clamp members being movable away  
17   from one another to increase the space between said first and second openings in an open  
18   position for said clamp to allow the feedwater sparger end bracket assembly to be  
19   positioned between said first and second clamp members with the first portion of the  
20   attachment plate and the first portion of the end plate aligned with said first opening and  
21   with the second portion of the attachment plate and the second portion of the end plate

22 aligned with said second opening, said first and second clamp members being movable  
23 toward one another to decrease the space between said first and second openings in a  
24 closed position for said clamp to receive the first portion of the attachment plate and the  
25 first portion of the end plate in said first internal compartment and to receive the second  
26 portion of the attachment plate and the second portion of the end plate in said second  
27 internal compartment; and

28 a connector securing said first and second clamp members to one another in said  
29 closed position, said clamp when secured in said closed position on the feedwater sparger  
30 end bracket assembly constraining the first portion of the attachment plate and the first  
31 portion of the end plate between said first internal walls and constraining the second  
32 portion of the attachment plate and the second portion of the end plate between said  
33 second internal walls.

2. The clamp as recited in claim 1 wherein said first internal walls comprise a  
2 first planar internal forward wall and a first planar internal rearward wall, said second  
3 internal walls comprise a second planar internal forward wall and a second planar internal  
4 rearward wall, said first planar internal forward wall being parallel to said first planar internal  
5 rearward wall, said second planar internal forward wall being co-planar with said first planar  
6 internal forward wall, and said second planar internal rearward wall being co-planar with  
7 said first planar internal rearward wall.

1           3.     The clamp as recited in claim 1 wherein the boiling water reactor vessel has  
2     a central longitudinal axis and said connector has a central longitudinal axis parallel to the  
3     central longitudinal axis of the boiling water reactor vessel.

1           4.     The clamp as recited in claim 1 wherein said first clamp member includes a  
2     first impingement shield extending toward said second clamp member and said second  
3     clamp member includes a second impingement shield extending toward said first clamp  
4     member to meet said first impingement shield in said closed position, said first  
5     impingement shield and said second impingement shield being disposed between the  
6     feedwater sparger end bracket assembly and the boiling water reactor vessel.

1           5.     The clamp as recited in claim 1 wherein said first clamp member includes a  
2     first inner shoulder transverse to said first internal wall and a first outer shoulder parallel  
3     to said first shoulder, said second clamp member includes a second inner shoulder  
4     transverse to said second internal wall and a second outer shoulder parallel to said second  
5     inner shoulder, said clamp in said closed position constraining the feedwater sparger end  
6     bracket assembly between said first inner shoulder and said first outer shoulder and  
7     between said second inner shoulder and said second outer shoulder.

1           6.     The clamp as recited in claim 5 wherein said first clamp member includes a  
2     first surface transverse to said first inner shoulder and said first outer shoulder, said

second clamp member includes a second surface transverse to said second inner shoulder and said second outer shoulder, said first transverse surface being disposed in opposition to said second transverse surface, said clamp in said closed position constraining the feedwater sparger end bracket assembly between said first surface and said second surface.

7. The clamp as recited in claim 5 and further including a first shim pad between said first inner shoulder and the feedwater sparger and a second shim pad between said second inner shoulder and the feedwater sparger.

8. The clamp as recited in claim 1 wherein said first internal walls are connected by a first internal transverse wall of said first clamp member, said second internal walls are connected by a second internal transverse wall of said second clamp member and further comprising a first spacer between said first transverse wall and the end plate and a second spacer between said second transverse wall and the end plate.

9. The clamp as recited in claim 1 wherein said first clamp member further includes a first shoulder extending between said first internal walls on a side of said first clamp member, a second shoulder extending from said first internal compartment in a first direction on an opposite side of said first clamp member and a tab spaced from said internal compartment in a second direction, opposite said first direction, on said opposite

side of said first clamp member, said second clamp member further including a first shoulder extending between said second internal walls on a side of said second clamp member corresponding to said side of said first clamp member, a second shoulder extending from said second internal compartment in said first direction on an opposite side of said second clamp member corresponding to said opposite side of said first clamp member, and a tab spaced from said second internal compartment in said second direction on said opposite side of said second clamp member, said clamp when secured in said closed position on the feedwater sparger end bracket assembly constraining the feedwater sparger end bracket assembly and the feedwater sparger between said first shoulders and said second shoulders and said tabs.

10. A clamp for installation on a feedwater sparger end bracket assembly connected to a conduit of a feedwater sparger at a sparger/bracket junction within a boiling water reactor vessel, said clamp comprising

an upper clamp member having a lower surface, an internal compartment open along said lower surface, an inner shoulder protruding downwardly from said lower surface and an outer shoulder protruding downwardly from said lower surface, said compartment being defined between spaced internal walls, said inner shoulder being parallel to said outer shoulder;

a lower clamp member having an upper surface, an internal compartment open along said upper surface, an inner shoulder protruding upwardly from said upper surface

11 and an outer shoulder protruding upwardly from said upper surface, said compartment of  
12 said lower clamp member being defined between spaced internal walls, said inner shoulder  
13 of said lower clamp member being parallel to said outer shoulder of said lower clamp  
14 member; and

15 a connector connecting said upper and lower clamp members with said upper  
16 surface spaced from said lower surface in facing relation therewith, with said compartment  
17 of said lower clamp member aligned with said compartment of said upper clamp member,  
18 with said inner shoulder of said lower clamp member aligned with said inner shoulder of  
19 said upper clamp member and with said outer shoulder of said lower clamp member  
20 aligned with said outer shoulder of said upper clamp member, said connector permitting  
21 adjustment of the space between said upper surface and said lower surface to receive an  
22 upper portion of the sparger/bracket junction in said compartment of said upper clamp  
23 member and a lower portion of the sparger/bracket junction in said compartment of said  
24 lower clamp member, said clamp constraining the sparger/bracket junction between said  
25 walls of said upper clamp member and between said walls of said lower clamp member,  
26 said clamp constraining the feedwater sparger end bracket assembly between said inner  
27 shoulder of said upper clamp member and said outer shoulder of said upper clamp  
28 member and between said inner shoulder of said lower clamp member and said outer  
29 shoulder of said lower clamp member, and said clamp constraining the feedwater sparger  
30 end bracket assembly between said lower surface and said upper surface.

11. The clamp as recited in claim 10 wherein said inner shoulder of said upper clamp member has a planar outer surface, said outer shoulder of said upper clamp member has a planar inner surface parallel to said outer surface, said inner shoulder of said lower clamp member has an outer surface co-planar with said outer surface of said upper clamp member, said outer shoulder of said lower clamp member has an inner surface co-planar with said inner surface of said upper clamp member, said clamp constraining the feedwater sparger end bracket assembly between said outer surface of said inner shoulder of said upper clamp member and said inner surface of said outer shoulder of said upper clamp member and between said outer surface of said inner shoulder of said lower clamp member and said inner surface of said outer shoulder of said lower clamp member.

12. The clamp as recited in claim 11 wherein said internal walls of said upper clamp member are parallel to one another and are perpendicular to said outer surface of said inner shoulder of said upper clamp member and to said inner surface of said outer shoulder of said upper clamp member, and said internal walls of said lower clamp member are co-planar with said internal walls of said upper clamp member, respectively.

13. The clamp as recited in claim 12 wherein said lower surface is planar and perpendicular to said internal walls of said upper clamp member, and said upper surface is planar and parallel to said lower surface.

1           14.    The clamp as recited in claim 10 wherein said inner shoulder of said upper  
2 clamp member is disposed between said internal walls of said upper clamp member, said  
3 outer shoulder of said upper clamp member extends from said compartment of said upper  
4 clamp member in a first direction, said inner shoulder of said lower clamp member is  
5 disposed between said internal walls of said lower clamp member, said outer shoulder of  
6 said lower clamp member extends from said compartment of said lower clamp member in  
7 said first direction, and further including a downwardly protruding tab on said upper clamp  
8 member and an upwardly protruding tab on said lower clamp member for being disposed  
9 between the conduit of the feedwater sparger and a wall of the boiling water reactor vessel  
10 with a close fit, said tab of said upper clamp member being parallel to said inner shoulder  
11 of said upper clamp member, said tab of said lower clamp member being parallel to said  
12 inner shoulder of said lower clamp member, said tabs being spaced from said  
13 compartments, respectively, in a second direction opposite said first direction, said clamp  
14 constraining the feedwater sparger between said inner shoulders and said tabs,  
15 respectively.

1           15.    A clamp for installation on a feedwater sparger end bracket assembly  
2 connected to a conduit of a feedwater sparger at a sparger/bracket junction within a boiling  
3 water reactor vessel, said clamp comprising



4 an upper clamp member for being assembled over a top of the feedwater sparger  
5 end bracket assembly, said upper clamp member including a compartment receiving an  
6 upper portion of the sparger/bracket junction, inner shoulder means along an inner side of  
7 the feedwater sparger end bracket assembly and outer shoulder means along an outer  
8 side of the feedwater sparger end bracket assembly for constraining the feedwater sparger  
9 end bracket assembly between said inner shoulder means and said outer shoulder means  
10 in a direction radial to the boiling water reactor vessel, and a surface disposed along the  
11 top of the feedwater sparger end bracket assembly, said compartment having wall means  
12 for constraining the sparger/bracket junction in a direction horizontal to the boiling water  
13 reactor vessel;

14 a lower clamp member for being assembled over a bottom of the feedwater sparger  
15 end bracket assembly, said lower clamp member including a compartment receiving a  
16 lower portion of the sparger/bracket junction, inner shoulder means along the inner side  
17 of the feedwater sparger end bracket assembly and outer shoulder means along the outer  
18 side of the feedwater sparger end bracket assembly for constraining the feedwater sparger  
19 end bracket assembly between said inner shoulder means of said lower clamp member  
20 and said outer shoulder means of said lower clamp member in said direction radial to the  
21 boiling water reactor vessel, and a surface disposed along the bottom of the feedwater  
22 sparger end bracket assembly cooperating with said surface of said upper clamp member  
23 to constrain the feedwater sparger end bracket assembly between said surfaces in a  
24 direction vertical to the boiling water reactor vessel, said compartment of said lower clamp

member having wall means for constraining the sparger/bracket junction in said direction horizontal to the boiling water reactor vessel; and  
connector means for connecting said upper and lower clamp members on the feedwater sparger end bracket assembly.

16. The clamp as recited in claim 15 and further including tab means on said upper clamp member and tab means on said lower clamp member disposed between the conduit of the feedwater sparger and a wall of the boiling water reactor vessel with a close fit for carrying moment on said clamp.

17. The clamp as recited in claim 15 and further including a recessed surface on said upper clamp member and a corresponding recessed surface on said lower clamp member, said recessed surfaces constraining the conduit of the feedwater sparger between said recessed surfaces in said direction vertical to the boiling water reactor vessel.

18. The clamp as recited in claim 15 wherein said upper clamp member includes an impingement shield disposed between the sparger/bracket junction and a wall of the boiling water reactor vessel, said lower clamp member includes an impingement shield disposed between the sparger/bracket junction and the wall of the boiling water reactor vessel, said impingement shields extending toward and meeting one another to isolate the sparger/bracket junction from the wall of the boiling water reactor vessel.

1           19. A method of preventing separation of a feedwater sparger end bracket  
2 assembly connected to a conduit of a feedwater sparger at a sparger/bracket junction  
3 within a boiling water reactor vessel, said method comprising the steps of

4           vertically separating an upper clamp member of a clamp from a lower clamp  
5 member of the clamp;

6           locating the upper clamp member over a top of the feedwater sparger end bracket  
7 assembly;

8           locating the lower clamp member over a bottom of the feedwater sparger end  
9 bracket assembly;

10          moving the upper and lower clamp members toward one another to position an  
11 upper portion of the sparger/bracket junction within a compartment of the upper clamp  
12 member and to position a lower portion of the sparger/bracket junction within a  
13 compartment of the lower clamp member;

14          securing the upper and lower clamp members to one another over the feedwater  
15 sparger end bracket assembly; and

16          leaving the upper and lower clamp members in place in the boiling water reactor  
17 vessel to prevent separation of the feedwater sparger end bracket assembly and to prevent  
18 separation of the feedwater sparger end bracket assembly from the feedwater sparger.

1           20. The method as recited in claim 19 wherein said step of leaving includes  
2           constraining the sparger/bracket junction in a first direction between walls of the  
3           compartment, respectively, constraining the feedwater sparger end bracket assembly in  
4           a second direction between a lower surface of the upper clamp member and an upper  
5           surface of the lower clamp member, and constraining the feedwater sparger end bracket  
6           assembly in a third direction between inner shoulders of the upper and lower clamp  
7           members, respectively, and outer shoulders of the upper and lower clamp members,  
8           respectively.

1           21. The method as recited in claim 20 wherein said step of moving includes  
2           positioning an upper portion of an attachment plate of the feedwater sparger end bracket  
3           assembly and an upper portion of an end plate of the feedwater sparger within the  
4           compartment of the upper clamp member and positioning a lower portion of the attachment  
5           plate and a lower portion of the end plate within the compartment of the lower clamp  
6           member.

1           22. The method as recited in claim 21 wherein said step of moving includes  
2           positioning an upper portion of a shim plate of the feedwater sparger end bracket assembly  
3           within the compartment of the upper clamp member and positioning a lower portion of the  
4           shim plate within the compartment of the lower clamp member.

1           23.    The method as recited in claim 19 wherein said step of securing includes  
2   securing the upper and lower clamp members to one another with a connector received  
3   in aligned bores of the upper and lower clamp members.

1           24.    The method as recited in claim 19 wherein said step of leaving includes  
2   transferring loads from the feedwater sparger to the boiling water reactor vessel via the  
3   clamp.

1           25.    The method as recited in claim 20 wherein said step of moving includes  
2   positioning a downwardly protruding tab of the upper clamp member between the conduit  
3   of the feedwater sparger and a wall of the boiling water reactor vessel at a location spaced  
4   from the inner shoulder of the upper clamp member and positioning an upwardly protruding  
5   tab of the lower clamp member between the conduit of the feedwater sparger and the wall  
6   of the boiling water reactor vessel at a location corresponding to the location for the tab of  
7   the upper clamp member.

1           26.    The method as recited in claim 25 wherein said step of leaving further  
2   includes balancing loads to which the clamp is subjected.

1           27.    The method as recited in claim 20 wherein said step of leaving further  
2   includes constraining the conduit of the feedwater sparger between recessed surfaces of  
3   the upper and lower clamp members, respectively.

1           28.    The method as recited in claim 19 wherein said step of leaving further  
2 includes isolating the sparger/bracket junction from a wall of the boiling water reactor water  
3 vessel via impingement shields of the upper and lower clamp members, respectively,  
4 disposed between the sparger/bracket junction and the wall of the boiling water reactor  
5 vessel.

1           29.    A constrained feedwater sparger end bracket assembly comprising  
2 a boiling water reactor vessel having a vessel wall;  
3 a feedwater sparger within said boiling water reactor vessel and including a conduit  
4 spaced inwardly from said vessel wall and having a conduit end;  
5 a feedwater sparger end bracket assembly connected to said conduit end at a  
6 sparger/bracket junction;  
7 a clamp disposed on said feedwater sparger end bracket assembly and including  
8 a first clamp member having a first compartment receiving a first portion of said  
9 sparger/bracket junction and a second clamp member, in opposition to said first clamp  
10 member, having a second compartment receiving a second portion of said sparger/bracket  
11 junction; and  
12 a connector securing said first clamp member and said second clamp member on  
13 said feedwater sparger end bracket assembly with said first compartment and said second  
14 compartment constraining said sparger/bracket junction against separation.

1           30.    The constrained feedwater sparger end bracket assembly as recited in claim  
2 29 wherein said first clamp member includes a pair of spaced shoulders and said second  
3 clamp member includes a pair of spaced shoulders, said feedwater sparger end bracket  
4 assembly being disposed and constrained between said shoulders of said first clamp  
5 member and between said shoulders of said second clamp member.

1           31.    The constrained feedwater sparger end bracket assembly as recited in claim  
2 29 wherein said first clamp member includes a first shoulder disposed between said  
3 feedwater sparger end bracket assembly and said vessel wall, a tab spaced from said  
4 shoulder and disposed between said conduit and said vessel wall, and a second shoulder  
5 spaced inwardly from said first shoulder and from said tab, said second shoulder being  
6 disposed between said first shoulder and said tab, said second clamp member including  
7 a first shoulder disposed between said feedwater sparger end bracket assembly and said  
8 vessel wall, a tab spaced from said first shoulder of said second clamp member and  
9 disposed between said conduit and said vessel wall, and a second shoulder spaced  
10 inwardly from said first shoulder of said second clamp member and from said tab of said  
11 second clamp member, said second shoulder of said second clamp member being  
12 disposed between said first shoulder of said second clamp member and said tab of said  
13 second clamp member, said feedwater sparger end bracket assembly being disposed and

- 14 constrained between said first shoulders and said second shoulders, said conduit being  
15 disposed and constrained between said second shoulders and said tabs.

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